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REPORT
CD NO.

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COUNTRY	Hungary	DATE OF INFORMATION	1951
SUBJECT	Economic - Industry, chemical, fuel		
HOW PUBLISHED	Monthly periodical	DATE DIST.	4 JAN 1952
WHERE PUBLISHED	Budapest	NO. OF PAGES	6
DATE PUBLISHED	Apr 1951		
LANGUAGE	Hungarian	SUPPLEMENT TO REPORT NO.	

THIS IS UNEVALUATED INFORMATION

SOURCE Magyar Kemiai Folyoirat, Vol V, No 4, 1951

COKING OF PEAT BRIQUETTES IN HUNGARY

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Hungary's peat supply consists of approximately 25 percent fibrous and 75 percent compact peat. The ash content is generally high and, therefore, only a fraction of the supply is suitable for coking. The fraction is large enough, however, to provide ample raw materials for decades to come for a peat-charcoal industry, should one be established.

Peat samples from various parts of the country were collected and these distilled at 500 degrees centigrade in a Fischer-Schader type 200 cubic centimeter aluminum apparatus. The samples were examined for water, ash, tar, and coke content, loss of gasses, and water of decomposition. At the same time, it was necessary to determine the water content and the ash content of the peat to be coked. The results are shown in the following table:

Peat Deposit	Moisture	Ash	Water of Decomposition	Tar	Coke	Gas Loss
Os	14.0	7.4	17.1	9.1	44.0	15.8
Lengyeltoti	12.9	23.1	13.9	7.0	49.5	17.5
Kalocsa	12.9	8.8	14.1	12.0	42.0	19.0
Feketeberzseny I	17.6	8.0	16.4	10.0	39.0	17.0
Feketeberzseny II	16.3	13.8	14.7	10.0	43.0	16.0
Izsak	5.5	56.8	9.5	5.6	71.1	8.3
Kisvarda	4.9	33.8	9.6	5.1	63.0	17.1
Kecel	11.9	26.6	10.1	8.7	55.0	14.3
Fonyoliget	10.3	16.9	6.1	9.5	50.0	24.9
Somogyszentpal	4.7	48.3	6.3	4.0	73.2	11.8
Ontes	8.2	39.5	9.3	5.0	63.0	14.5
Balatonlelle	5.4	41.0	9.6	4.5	66.5	14.0
Madasladany	8.5	36.6	10.5	4.3	65.0	11.7

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According to Puchner (Der Torf, Stuttgart, 1920, p 251), peat which contains more than 10-percent ash is not suitable for coking. After coking, the ash content increases to such an extent that the coke loses most of its strength. In practice, the disadvantage of this type of peat does not lie in the fact that it yields little heat, but rather in the fact that coke containing a large proportion of inert material cannot retain its shape. Experiments have shown that peat containing 50 to 60 percent of inert material is extremely brittle.

Experiments have also shown that some domestic peat contains less than 10 percent of ash when air dried. Peat originating from Kalocsa, Os, and Feketebezseny is of this type.

Up to now, explorers have consistently neglected to look for peat deposits of the low ash-content variety. This has been the reason for obtaining results which fell below expectations.

To obtain shape-retaining, strong briquettes, the raw peat has to be shaped before coking. It may be formed into briquettes with or without the application of mechanical power.

It was shown during experiments that a strong, shape-retaining coke can be produced from peat briquettes in spite of Puchner's statement to the contrary.

During the course of the experiments, Professor Gusztav Tarjan acted as consultant to determine how a peat briquette of excellent quality could be produced. Two factors are very important in the production of high-quality briquettes: the size of the particles and the water content which produces the best possible cohesion. This water content is called the optimum water content.

The peat from Os had an optimum water content of 16.86 percent when it was briquetted. The following chart compiled by Gusztav Tarjan shows the strength of briquettes of various lengths under a pressure of 820 atmospheres in each case:

Pressure (atm)	Length (mm)	Diameter (mm)	Weight (gr)	Volume (cu cm)	Specific Gravity	Strength (kg/cu cm)
820	16.5	50	35.5	32.4	1,094	500
820	22.0	50	48.0	43.1	1,112	244
820	27.5	50	59.0	54.0	1,092	167

The following chart was prepared on the basis of different pressures on briquettes of more or less equal size.

Pressure (atm)	Length (mm)	Diameter (mm)	Weight (gr)	Volume (cu cm)	Specific Gravity	Strength (kg/cu cm,
820	27.5	50	59.1	54.0	1,093	167
510	29.5	50	57.5	57.9	994	69
385	31.5	50	55.9	61.8	94	23

The experimental data show that in the case of peat briquettes of identical dimensions the breaking strength per cubic centimeter increases with increased pressure. This is not true of Kalocsa peat. Briquettes were prepared which seemed to be of excellent composition, but began to crack after a few minutes and finally crumbled.

Small briquettes were first coked in the laboratory and, after obtaining favorable results, systematic experiments were initiated.

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When preparing small briquettes in the laboratory, it was not possible to determine the amount of pressure used. Before preparing large briquettes, howeve . it was necessary to determine the approximate amount of pressure required. It was hoped that by applying the same pressure, a product similar to the small laboratory briquettes could be obtained.

	Percent
Residue on the No 100 mesh sieve	12.5
Passed through the No 100 mesh sieve	8.6
Passed through the No 300 mesh sieve	23.6
Passed through the No 560 mesh sieve	12.3
Passed through the No 900 mesh sieve	41.9

Ten small laboratory briquettes were prepared from the above material. The briquettes were weighed, their volumes were established, and it was determined that 1.073 grams of peat were compressed in one cubic centimeter of material. In every case briquettes, 35.6 millimeters in diameter, were prepared from 70 cubic centimeters of ground peat. Various pressures were applied and the amount of peat compressed per cubic centimeter was calculated.

The following data were obtained:

Pressure (atm)	300	250	200	150	100	50
Diameter (mm)	35.65	35.60	35.90	35.90	35.90	35.90
Surface (sq cm)	9.95	9.90	10.13	10.13	10.13	10.13
Height (mm)	23.00	24.60	25.00	25.10	26.40	29.20
Volume (cu cm)	22.90	24.30	25.30	25.35	26.80	49.58
Weight (gr)	28.34	29.80	29.25	27.66	26.98	24.84
Pressure (kg/sq cm)	1,450	1,210	950	710	475	238
Peat in 1 cubic centimeter of briquette (gr)	1,235	1,223	1,255	1,093	1,004	0.842

The above table shows that the 1.073 grams per cubic centimeter of peat, present in the small laboratory briquettes, was also present in the large briquettes which were prepared under a pressure of about 700 kilograms per square centimeter. This led to the conclusion that the laboratory briquettes must have been prepared under the same or at a somewhat lower pressure. The above chart shows that it is necessary to apply a pressure of 700 kilograms per square centimeter in the preparation of large laboratory briquettes.

Peat briquettes, 36 x 25 millimeters, were prepared for coking from Os peat of low ash content. The weight of one briquette was approximately 29 grams. The water content of the peat used was 17 percent and the ash content was 5.9 percent. The pressure applied was 1,200 kilograms per square centimeter.

During experiments, the briquettes were coked in a vacuum at a temperature of about 800 degrees centigrade. It was found that at this temperature the briquettes obtained retained their shape, were strong and similar to coke.

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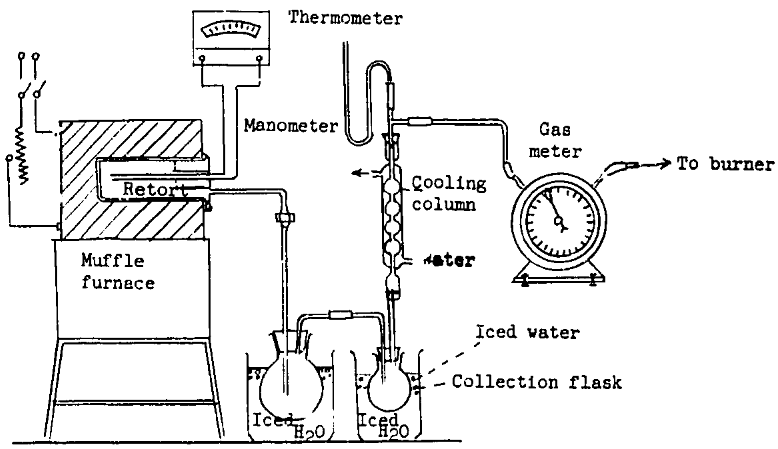
An iron-alloy retort, 150 x 80 x 260 millimeters, was used for coking the peat briquettes. A steam and gas outlet tube, approximately 60 centimeters long, was mounted on the closely fitting lid of the retort. A two-holed cork stopper was put on the gas outlet tube on which a wide-necked flask was placed to receive the condensed yield. A U-shaped gas outlet tube was placed in the other opening of the stopper and a cork stopper with one hole was placed on its other end. A cooling column was placed in the other opening of the cork and another flask was attached to receive the cooled-off liquid yield. A T-shaped tube was led through a stopper on top of the cooling column. One end of the tube was led into a manometer and the other into a gas meter. A pyrometer was installed in the lid of the metal retort. A Hoskins heat element pyrometer filament was placed in it to control the coking temperature and the heat in the retort. The collection flasks were submerged in iced water to achieve more perfect cooling.



There were no data available regarding the optimum temperature of coking, so that, at the start of the experiments, 800 degrees centigrade was selected arbitrarily, together with 3 hours of coking time. Later it was found that this long period of time is not required for coking, since the coking process requires only a few minutes once the optimum temperature is reached.

It was found experimentally that the optimum temperature for coking Os peat briquettes is 765-775 degrees centigrade. If the temperature is raised above this range, no additional yield or products are obtained. This can be explained by the fact that, once the volatile substances have left, which occurs at lower temperatures, the coke does not undergo any further decomposition. The surface of the coke obtained is slightly shiny, its color is metallic grey, and its inner breaking surface is dark grey or black. The peat briquette retained its shape unchanged after coking although it shrank 50 percent in the process. The coked peat briquette is a solid material and breaks only under higher pressure. After coking cracks appeared on the surface of the cylindrical briquettes.

The best quality coke was obtained by coking the material at 775 degrees centigrade. The ash content of peat briquettes coked at this temperature is 16.45 percent and heating value is 6,735 calories at a temperature above 775 degrees centigrade. Material coked at a temperature lower than 775 degrees centigrade shows less strength. It is noteworthy that this temperature was established through arbitrary estimates, since the material available was insufficient for the exact determination of strength data.

At 775 degrees centigrade, the peat coke yield was 37.9 percent which means that, in practice, 270 kilograms of peat briquettes yield 100 kilograms of coked peat briquettes. At 750 degrees centigrade, the yield is 43.4 percent, but the coke is very brittle and weak. When coked at a temperature of more than 750 degrees centigrade, the yield is not reduced significantly. It is not desirable to coke at a temperature higher than 775 degrees centigrade, because the resulting improvement in quality would not warrant the added strain on coking facilities.

The coked peat briquette prepared from Os peat briquettes contains a large quantity of sulfur. It appears from the analysis that approximately 40 percent of the sulfur present in the peat can be detected in the coke. As a result of moist air, the coked peat briquettes produce an unpleasant odor, due to the action of water on the sulfur and hydrogen. This leads to the conclusion that the sulfur, present in the coke, is bound to the calcium in the ash in the form of a sulfide. It is a well-known fact that sulfide is decomposed by the action of water.

The following table shows the approximate decomposition of the coked Os peat briquette ash:

	Percent
Moisture	0.16
SiO_2	26.94
TiO_2	0.55
Al_2O_3	19.30
Fe_2O_3	9.06
CaO	31.65
MgO	6.07
K_2O	1.01
Na_2O	0.69
P_2O_5	0.21
Total sulfur	2.48
Loss in weight due to heat	1.25

The above analysis indicates that the ash is composed for the most part of calcium, magnesium, silicon, iron, and aluminum oxides.

Among the by-products of the coking process, the quantity of tar is hardly greater than that produced in the aluminum retort. In the case of water, it was found that the moisture content, plus the water of decomposition, was smaller than the quantity of water obtained in the aluminum retort. The reason for this is that the larger laboratory coking retort is lined with an asbestos material which absorbs and retains a considerable quantity of water.

Experiments were conducted to determine the reasons for the cracks on the surface of the cylindrical coke briquettes. Perfect peat briquettes were heated in a retort to the point of dryness and after coking, they were removed and examined. At 100 to 130 degrees centigrade, without exception, these briquettes cracked. Moreover, the openings of the cracks were much larger than those observed on the coked briquettes. This is explained by the fact that during coking, as a result of the reduction of volume, a constriction of the openings takes place. It may be assumed, therefore, that the chances for preparing crack-free coked briquettes from air-dry peat briquettes are very poor. If completely dry peat is used, the belief is justified that the number of cracks will be reduced.

Puchner's statements concerning the coking of peat briquettes are not valid in the case of the Os peat briquettes, since experiments prove that shape-retaining coked peat briquettes of good strength can be obtained.

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The question of cohesion is an important one. It is the opinion of the writer that the cohesion of the Os peat briquettes can be ascribed to the coking process. It was found that if small laboratory briquettes were coked at 350 to 500 degrees centigrade, the semicoked peat briquettes retained their shape, but their strength was so unsatisfactory that they crumbled under the least force. The briquettes are black and there is no indication on their surface of any incipient coking process. On the contrary, the peat briquette coked at 750 degrees centigrade is shiny grey and its strength is greatly increased. At this temperature, the transformation into coke takes place at a very rapid rate, almost in a matter of seconds. When processed under 750 degrees centigrade, the coke is noticeably weaker.

In the above experiment, great care was taken not to introduce any foreign matter which would have facilitated the coking process or increased the strength of the coke. Yet, it was thought interesting to observe the effects of a binder on the coking process. Prior to briquetting the peat, 1, 2, and 3 percent of coal tar was added. The peat was then briquetted and processed for coke at 775 degrees centigrade for 5 minutes. The surface of the briquettes was covered with small cracks. The openings were perhaps slightly smaller, but the results were not sufficiently rewarding to warrant any further investigation of this matter.

A separate series of experiments were conducted to determine the change in peat briquettes kept at room temperature, when they were placed in an oven, preheated to 800 degrees centigrade. The peat briquettes crumbled without exception and the pieces were coked. It was surprising that even under such rough treatment no dust was formed. It was necessary to conduct these experiments to find out what would happen if industrial experiments involving coke briquettes had to be conducted in a retort distillation apparatus.

The coking of peat briquettes can be done only under certain conditions. It can be done only if the material involved does not tend to change its shape after briquetting. This question led to the investigating of the possibility of applying mechanical power to the manufacture of peat. Another series of experiments was initiated to study this question and its results will be published in a separate article.

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